WHAT IS CLAIMED IS:

1. A message-passing decoder for low-density parity-check (LDPC) codes, which is for decoding block codes encoded with LDPC codes by a message-passing decoding algorithm, the message-passing decoder comprising:

a log likelihood ratio calculator for receiving a code word having a consecutive value from block codes encoded with the LDPC codes, and calculating a log likelihood ratio;

a bit node function unit for calculating a bit message using the log likelihood ratio calculated by the log likelihood ratio calculator and an input parity-check message;

a check node function unit for calculating the parity-check message using the bit message calculated by the bit node function unit, and outputting the calculated parity-check message to the bit node function unit; and

a parity checker for receiving a code word decoded by the bit node function unit from the final parity-check message calculated by a repeated decoding of the bit node function unit and the check node function unit, and checking a parity,

wherein the parity-check message corresponding to a logic function output for an input from the bit node function unit is calculated according to a linear approximation function determined for each divided interval of the logic function.

2. The message-passing decoder as claimed in claim 1, wherein the

check node function unit comprises:

a multiplier for multiplying the input from the bit node function unit by a slope of the linear approximation function for each interval;

a summator for adding a boundary value of the linear approximation function for each interval to an output value of the multiplier; and

a multiplexor for selecting an output of the summator according to an interval range of the input.

3. The message-passing decoder as claimed in claim 1, wherein the check node function unit comprises:

a slope calculator for calculating a slope, to be multiplied, from a bit of the highest order other than "0" in the input from the bit node function unit, and multiplying the slope with a bit shifter and a summator;

a boundary calculator for calculating a boundary value of the linear approximation function for each interval from the bit of the highest order other than "0" in the input; and

a summator for adding the boundary value calculated by the boundary calculator to an output of the slope calculator.

4. The message-passing decoder as claimed in claim 3, wherein the slope calculator comprises:

a bit shifter for shifting each bit of the input to the left or right side so as to construct the slope;

a ground for expressing a value of "0" used in the calculation of the

slope;

a word negater for inverting an output of the bit shifter by each word sign to express the slope; and

a switch for combining the outputs of the word negater and the ground to output a final result.

5. The message-passing decoder as claimed in claim 4, wherein the boundary calculator comprises:

a bit shifter for shifting each bit of the input to the left or right side so as to construct the boundary value;

a ground for expressing a value of “0” used in the calculation of the boundary value;

a word negater for inverting an output of the bit shifter by each word sign to express the boundary value; and

a switch for combining the outputs of the word negater and the ground to output a final result.

6. The message-passing decoder as claimed in claims 1, wherein the logic function $\Phi(x)$ satisfies the following equation:

$$\Phi(x) = -\log\left(\tanh\left(\frac{|x|}{2}\right)\right)$$

wherein x is the input from the bit node function unit.

7. The message-passing decoder as claimed in claim 6, wherein the

interval I_i of the linear approximation is determined by the following equation:

$$I_i = \left[2^{K+i} 2^{K+1+i}\right], \quad i \in \{0, \ \cdots, \ n_1 - 1\}, \qquad K = -n_2$$

wherein n_1 is the length of a word expressing the input, i.e., a word length; and n_2 is the bit corresponding to a minimum resolution of decimal places expressing the input,

the boundary value on either side of the interval being the power of 2.

8. The message-passing decoder as claimed in claim 7, wherein the linear approximation function y satisfies the following equation:

$$y = s_i \gamma + x_i, \qquad i \in \{0, \ \cdots, \ |\{I_i\}| - 1\}, \qquad r \in I_i$$

wherein s_i is the slope; and x_i is the boundary value.

9. The message-passing decoder as claimed in claim 8, wherein the slope s_i satisfies the following equation:

$$s_i = ROUND\left(\frac{\Phi\left(2^{K+n_1-i-1}\right) - \Phi\left(2^{K+n_1-i}\right)}{2^{K+n_1-i-1} - 2^{K+n_1-i}}, \quad n_2\right), \qquad i \geq 0$$

wherein the ROUND function is a function for designating the input as the most approximate one of binary numbers given by 2^{-n_2} as the minimum resolution,

the ROUND function satisfying the following equation:

$$ROUND(x, \quad n_2) = 2^{-n_2}\left\lfloor \frac{x}{2^{-n_2}} + \frac{1}{2} \right\rfloor$$

10. The message-passing decoder as claimed in claim 9, wherein the

boundary value x_i satisfies the following equation:

$$x_i = ROUND\left(\left(2^{K+n_1-i} - 2^{K+n_1-i+1}\right)s_i + x_{i-1}, \quad n_2\right), \qquad i \geq 1,$$

$$x_0 = ROUND\left(\Phi\left(2^{K+n_1}\right), \quad n_2\right)$$